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ESCHSCHOLTZIA CALIFORNICA. CHAMISSO.

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DESCRIPTION OF PLATE.

FIG. 1.—Base of one of the petals, to which some of the stamens are attached.

FIG. 2.—Apex of an anther.

FIG. 3.—Pistil inserted in the cup-shaped receptacle, or hollowed extremity of the peduncle.

FIG. 4.—Section of the germen.

FIG. 5.—Ripe capsule (natural size).

FIG. 6.—Seed.

FIG. 7.—Section of seed.

FIG. 8.—Embryo.

All but figure 5 more or less magnified.

Much interest has recently been excited by the announcement of the discovery of morphine in the Californian plant *Eschscholtzia californica*, Cham., that alkaloid having been previously known to exist only in the poppy plant. Aside from the economic and therapeutic value of the discovery, it being expected that the new drug will exhibit special advantages over opium in many of its uses, a special interest attaches to it from a pharmaceutico-botanical point of view, as there is scarcely any member of the poppy family in which the discovery of morphine might have been considered so improbable as in this. Had *Papaver somniferum* been the only species of its genus, or even the only one in which morphine had been sought, we might have looked upon its occurrence elsewhere as not at all surprising. But the genus Papaver contains some fifteen or twenty species, well distributed through Europe, Asia, Africa and Australia, with one in California. It forms, moreover, a very natural group, and the close structural affinities of its members would have led us to look for more or less community in the important feature of the production of morphine among them. But, notwithstanding that they have been abundantly studied, one of them being an important article of the Materia Medica, no trace of morphine has yet been discovered outside of the one species. Not only will these remarks apply to the other species of Papaver; the family is rich in medicinal plants, Arge-

mone, Bocconia, Sanguinaria, Cheledonium and Glaucium, all being either generally or locally known in medical practice. In none of them has morphine been found, although it has doubtless been sought with more or less thoroughness in all. Yet all these genera, and others, intervene structurally between Papaver and Eschscholtzia, the botanical characters which separate these two genera being as broad as the areas which part their respective habitats; the structure of the broad, globular pods of the poppy, with their many lobed stigmas, and discharging their seeds, not by splitting, but through a number of small, apical orifices, is familiar to every student of Pharmacy. Eschscholtzia, on the contrary, produces a greatly elongated, slender pod, not unlike a couple of matches set end to end, and discharging its seeds by splitting throughout its entire length into two valves. These radically different plans of structure separate Papaver, with all the genera above-named, into a distinct sub-order, *Eupapavereæ*, from that composed of Eschscholtzia, Hunnemannia, and Dendromecon, namely, the *Hunnemanniæ*. But even in its own sub-order, Eschscholtzia is very peculiar, constituting a genus anomalous in the whole family by having its sepals coherent over the corolla and falling as the flower opens, as well as in its perigynous petals and stamens. Its erratic nature is now still further asserted by the possession of so rare a chemical base.

The discovery leads us to inquire, is morphine really absent from all other branches of the family? It will now appear somewhat improbable that such is the case, and if the alkaloid discovered in Eschscholtzia really be morphine, on which point we are justified in coming to a conclusion slowly, we shall expect the researches to which chemists must be stimulated by the recent discovery to result in locating this principle elsewhere. California herself is rich in Papaveraceæ, boasting no less than eight genera and a dozen or more speices, outside of Eschscholtzia, numbering among them one species of genuine Papaver. Another genus, Dendromecon, with three species, is the near relative of Eschscholtzia, while its other congener, Hunnemannia, " scarcely distinguish-

able" from it, grows in neighboring Mexico. Our enterprising Californian brethren are not likely to neglect their opportunities for investigating the composition of these interesting plants. Neither would investigation of the species of the neighboring family Fumariaceæ—by modern authors classed as a sub-order of the Papaveraceæ—be misplaced, as Eschscholtzia is very near to that family.

There is a second point of view from which the study of Eschscholtzia greatly interests us. Should it develop that morphine is really absent, as supposed, from the other genera of Papaveraceæ, and from all the other species of Papaver, then we may reasonably expect that its presence in Eschscholtzia may be equally restricted, and that it may not occur outside of the one species. The strong possibility, at least, of such a restriction is sufficient to lead to great care in the selection of the drug, and we should do well to avail ourselves of every source of botanical information concerning the group. The consideration, moreover, will work both ways, as the limits of the species are by no means settled beyond dispute, and their chemical affinities may, under the circumstances, very readily throw some light on their proper botanical arrangement.

The most extended critical study which these plants have received has been at the hands of Prof. Edward Lee Greene, of the University of California, whose revision, reproduced below, appeared in 1885 in the *Bulletin of the California Academy of Sciences*, No. 3, and was supplemented by additions in the succeeding number and in *Pittonia*, I, page 43.

The genus was founded by Chamisso, *Hor. Berol.*, '73, where the single species, *E. californica* was described. Lindley afterward set aside the name Eschscholtzia, and substituted that of Chryseis, but his grounds were insufficient, and the original name was afterward restored and has since been retained, except in the *Flora of North America*, by Torrey and Gray, where Lindley's name was used. De Candolle, in the *Prodromus*, still describes but one species, but others were subsequently added, until in 1838 five species were described by

Torrey and Gray. A sixth species was subsequently added. In 1876 Watson reduced all these species to varieties or forms of E. Californica, adding however, a species of his own, *E. minutiflora*. In March, 1885, Prof. Greene revised the genus as above stated, describing ten species, adding an eleventh later. Two years later Dr. Gray presented a synopsis of the genus, *Proc. Am. Acad.*, XXII, in which nine of the species adopted by Prof. Greene were recognized. Other botanists have since declared that this number of species is far too large.

Thus it will be seen that whatever reputation Eschscholtzia may be entitled to as a drug, must be jealously guarded against blemishes resulting from an ignorant admixture of species in collecting. Fortunately, there are some peculiarities of habitat which, for the present at least, if observed, will rule out most of the probabilities of error. *E. californica* is the common coast species, reaching back to the foot of, but not much ascending into, the Sierra. This is sufficient to enable collectors to discriminate against the somewhat similar *E. rhombipetala* and the very similar *E. Austinæ*, which grow among the mountains and apparently do not reach the coast at all. This statement applies to the northern part of the State. Southward, *E. californica* does not grow upon the coast, but is said to grow sparingly among the mountains. This would seem to indicate that the species is quite susceptible to climatic influences which closely determine its habitat. This view would seem to be strengthened by the fact of its growing freely in the vicinity of Valparaiso, Chili, near the coast, while it is not reported from the warmer regions between that point and San Francisco, where its introduction would naturally be expected. Yet its continued restriction to its present habitats is uncertain, and collectors will do well to study the table of Prof. Greene.

The great beauty of this plant was appreciated by gardeners almost from the time of the first description by Chamisso, and it was early introduced to cultivation. Under cultivation, sprouts were produced presenting variations from the uniform lemon-yellow of the petals. In its natural habitat too, varieties were discovered present-

ing lighter or darker shades of color, with differently colored centre and margin to the corolla. These varieties were introduced to cultivation, where the peculiarities were strengthened, so that quite a large number of varieties were soon upon the market. Though somewhat out of fashion at the present time, these plants have held their own and are still considered among the loveliest of bedding plants.

In the arrangement of Bentham & Hooker, the genus Eschscholtzia is the 8th of the Papaveraceæ, and is thus characterized:

Sepals coherent, calyptra deciduous. Petals four. Stamens indefinite. Placentæ two, nerviform; style short; stigma divided into four to six linear divergent lobes. Capsule linear, ten sulcate, dehiscent entirely to the base, the valves rigid, recurved, margins placentiferous, seeds not at all cristate. Leaves multisect, linear. Flowers yellow, long peduncled. Torus at the apex more or less cupular-dilated, the stamens and petals perigynous.

The following is Prof. Greene's arrangement of the species, with the addition of *E. glauca*, *E. elegans* and *E. Parishii*, which I have introduced where his descriptions would seem to indicate that they belong.

* *Petals broad, overlapping each other in the open flower except in the last species, persistent for two or more days.*

+ *Corolla funnelform to widely campanulate, never rotate-expanded.*

++ *Outer margin of the torus forming a broad, herbaceous, spreading rim.*

E. californica, Cham.

Perennial, very smooth, and slightly glaucous; stems usually weak and decumbent, freely branching; petals an inch or two long, yellow with an orange spot at base, or more commonly brilliant orange throughout: inner margin of the torus short, thin, and nerveless: seed with prominent favose reticulations.—*Watson, Bot. Cal.* I, 22.

Common from the sandhills along the seaboard to the foothills of the Sierra. The stouter, more erect, less branching form, with the largest and most deeply colored corollas, belongs to the interior, extending northward to Oregon and Washington, where it is known as the *var. Douglasii*, Gray; but it does not seem to merit even a varietal name.

E. glauca.

Perennial, very glaucous, erect, 2–4 feet high, of a loosely cymose and sometimes distinctly dichotomous inflorescence; leaves small, their segments linear and little divergent;torus with a narrow but manifest spreading rim; petals an inch long, with orange spot at base and commonly a narrow border of the same color at the truncate summit, otherwise light yellow; seeds globular, reticulated; cotyledons linear, cleft to the middle.

On dry clayey hillsides of the interior basin of Santa Cruz Island. Near *E. californica*, and best distinguished from it by the peculiar glaucous whiteness of the herbage, and by the profusion and the cymose arrangement or its flowers. The red margin of the corollas, if it were broad enough to be conspicuous, would make this plant a great desideratum with cultivators.

E. peninsularis.

Annual, smooth and glaucous, slender, erect, much more branched than the preceding, with corollas of one-third the size and more broadly campanulate; rim of torus broader in proportion, the inner margin a very short, nerveless, hyaline ring; seed slightly elongated and distinctly apiculate at each end, reticulations less regularly favose.

Mountains of the peninsula of Lower California; collected by Mr. C. R. Orcutt, July, 1884.

A very freely branching species with the habit of *E. minutiflora*, but more nearly allied to *E. californica*.

++++ *Torus without conspicuous rim.*

E. mexicana.

Annual, smooth and glaucous; foliage less finely dissected; stems short; peduncles numerous, stout, and scape-like; petals an inch long, yellow or cream color; torus short, obconical, the outer margin a sub-cartilaginous ring, the inner erect, scarious, with stout nerves; seed globular apiculate, with coarse but rather faint reticulations.—*E. californica*, var. *parvula*. Gray. Pl. Wright, 2, 10. *E. Douglasii*, Torr. Mex. Bound, 31; Hemsl. Biol. Cent. Am.

This plant ranges from the region of the upper Gila, in New Mexico, far southward into Texas and adjacent Mexico, and is apparently a very good species.

E. Austinæ.

Perennial; stems slender, erect, and branching, hirsute below, only sparingly scabrous, or sometimes quite smooth above; segments of the leaves slender and remote; petals yellow, an inch long; torus almost cylindrical, only a little widened above, the outer margin a faint herbaceous ring, the inner deeper and hyaline; seeds with conspicuous but irregular reticulations.

Collected in Butte county, 1883, by Mrs. R. M. Austin; also in the same year, further down the Sacramento Valley, near Elmira, by Mrs. Curran. Doubtless a common species of the region, and one which in the collections would naturally be put in with *E. californica* by those who disregard the importance of the character of the torus.

I gladly dedicate the species to one of the most intelligent and helpful of our field students of California botany.

The hirsute, or sometimes chiefly short, scabrous pubescence, often extending even to the calyx, is wholly wanting in the smaller of Mrs. Austin's specimens, which are nevertheless distinguishable from *E. californica* by the torus, and by the seeds, which are less regularly reticulate than in that species.

++ *Corolla rotate-spreading; annual species, with the two margins of the torus similar and closely approximate.*

E. tenuifolia, Benth.

Sparingly hirsute-scabrous; stems very short; leaves subradical, their lobes few, long, and linear-filiform, or more numerous, shorter, and a little wedge-shaped; peduncles scape-like, very slender, and exactly quadrangular; petals a half inch long, usually pale yellow, never orange; seeds not reticulated, but more or less clothed with prominent tuberculations, or even lignate projections.—*E. cæspitosa*, and *E. hypecoiaes*, Benth.

Common on the western slope of the Sierra Nevada. It is not improbable that *E. cæspitosa* will also have to be restored on the strength of the characters of the seed alone. Our material is not yet sufficient, however, to fully warrant such action.

E. glyptosperma.

Wholly glabrous and very glaucous; stems very short; leaves much dissected, but short and compact; scape-like peduncles numerous, six inches high, terete, and rather stout; corolla as in the preceding species, but of a deeper yellow; seeds not reticulate, but deeply pitted and of an ash-gray color.

A most peculiar species, collected in 1884 by Mrs. Curran, on the Mohave Desert. The seeds are remarkably unlike those of any other known *Eschscholtzia*.

E. minutifloria, Watson.

Smooth and very glaucous, a foot or more high and much branched; corolla 3 lines broad, greenish yellow; double character of margin of torus hardly perceptible; seeds reticulate.—*Proc. Am. Acad.*, XI, 122, and *Bot. Cal.*, I, 23.

The description of this species is drawn from specimens brought from the Mohave Desert. I have seen none from any of the more easterly localities.

E. elegans.

Annual, a foot or two high, branching above the base, glabrous and very glaucous; leaves finely dissected, their ultimate divisions linear, long and parallel, or shorter and divergent; torus cylindrical, the two margins closely approximate, the inner one erect and hyaline; petals 4–8 lines long, rotate-expanding, their margins hardly meeting, greenish yellow when fresh, turning toward orange in drying; seed slightly elongated, apiculate, raphe obvious, reticulation distinct or obscure.—*E. californica*, var. *hypecoides*, Gray, of Watson's list, as to the plant of the south part of Guadaloupe Island, not of Bot. Cal.

Var. RAMOSA.—Shorter, stouter, more branching and leafy;

leaf-lobes shorter and divergent, corolla smaller, reddening less in drying; seeds nearly globular and distinctly reticulate.

This type is common in the middle and southern parts of the island. The variety was found under high cliffs near the landing at the north-east end. The foliage in both forms is strikingly beautiful. The erect, compact, tree-like habit of the variety is peculiar. Very likely it deserved the rank of a species. Nothing much like either form is known on the main land. The nearest relatives are *E. minuti flora*, Watson, and *E. rhombipetala*, Greene.

E. Parishii.

Annual, slender, less than a foot high, glabrous and glaucous; stems simple or sparingly branched; peduncles terete, very slender; torus turbinate, no spreading rim, the two margins similar and approximate; petals widely spreading, broad and overlapping each other, apparently light yellow; fruit not seen.

Eastern slope of Mt. San Jacinto in the southern part of the State, collected by the Parish Brothers (No. 759) in April, 1882. In habit resembling *E. peninsularis*, but with the torus and corolla (but not the quadrangular peduncles) of *E. tenuifolia*. The different corolla, the long slender peduncles, and the leaves (mostly radical), are in the way of its being included in *E. elegans* of Guadaloupe, to which it is apparently most related.

* * *Petals narrower, their margins not meeting when open, fugacious.*

E. rhombipetala.

Tuberculate-scabrous throughout and glaucous; stems with stout, depressed branches; peduncles quadrangular, stout, little exceeding the sub-radical leaves; petals rhombic-ovate, a half-inch long, fugacious; capsules 3-4 inches long, nearly equaling the peduncles; torus cylindrical, becoming scarious above, the two margins alike, and easily distinguishable; seeds large, the reticulations very distinctly and regularly honeycombed.

A most distinct and peculiar species, found chiefly in the lower San Joaquin Valley, but also observed by Mrs. Curran in Colusa county. Most of our specimens in the herbarium want the petals, it being impossible to obtain them unless the collecting is done in the early part of the day.

The peculiar roughness of the plant extends even to the capsules, and is conspicuous on the angles of the peduncles. The pods and seeds are as large as in the rankest forms of *E. californica*, although the entire plant is very much smaller than even the middle-sized specimens of that species.